WHITE PAPER

BAA Number: **09-013**

Proposed Title: **Compact Hollow Fiber Membrane System**

Relevant BAA Topic Area: **Advanced Pretreatment**

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Date: April 1, 2009

TECHNICAL CONCEPT

Our versatile membrane module system for on board ship water treatment is a stackable rack of "square" modules containing metal housings designed to incorporate any type of hollow fiber membranes. This militarized configuration allows: significantly reduced shipboard space; minimal operator contact during change out; individual module testing; and the ability to swap out single modules in a rack--no shutdown of any part of the system for maintenance.

Our concept is a unitized modular system for Navy applications. Each module consists of a metallic housing containing the fiber bundle with connection hardware including feed and drain distribution headers. Independent of this housing as an integral part of the module is a serpentine aeration header. The modules are easily swapped out upon membrane failure with spares or can remain in the on the rack disconnected without disruption of system operation. Once in port modules are exchanged. New membranes can be inserted into the reusable modules.

The goal is to reduce the size of the overall system, maintain the integrity of a durable operational system; and incorporate current drain/flush/aerate cleaning schemes currently developed and proven by the Navy. We will build on this work by producing a system with a 60% reduction in size. The square metal modules are lightweight, and made from titanium, stainless steel or duplex alloys. The reusable housing containing the hollow fiber bundle is made of lightweight metal and the fiber bundle is easily swapped out.

The system's unique design places all feed/concentrate/drain/air/vent functions on one end of each module and can be horizontally or vertically configured--allowing the drain/aeration step preferred by the Navy. The modules can be mounted on the floor, against a wall or mirrored on either side of a common feed header and can be sampled for filtrate quality individually. Prepackaged metal/titanium modules prevent environmental or personnel contact with the membrane fibers.

All contact points (exterior surfaces/fittings) are metallic and each module is isolated from the main feed header via a short snap connector. A key feature of the module is a special connector for all inlets/drains/air/vent connections from the module to the main piping system. These connectors are available in military grade and they have a self closing feature. This feature allows the connection from fluid lines to be disconnected from one another while the system is in operation without spilling more than a few drips of water. The all-metal module provides a robust design to meet the Navy's criteria for 30-year life; vibration and shock; is non-flammable and reduces spare parts requirements by 50%. The module can use any currently available or new hollow fiber membranes assuring long term supplies of low cost replacement bundles.

The end (non feed/vent/air/drain) side of the module has a steel handle with a release lever for each module which is integral to the rack. By pulling this one handle all disconnects are disengaged and the module can be pulled from a rack with no disruption of the system. The module design incorporates internal flow paths for feed/drain/vent/air into the fiber bundle during manufacturing.

Comparing the Memtek (80" tall x 7" diameter) module (Port Hueneme) to our concept design (40" tall by 6" x 6" square) we provide a 50% reduction in overall system size using the exact same Memtek fiber. Calculations are based on volume available for fiber bundles in the module which is a direct packing density comparison.

Our concept header design will be optimized to provide another 10% system volume reduction over the current Memtek design. The Memtek has a 7" x 7" square header on the top and bottom of the module. The new module will "feed/vent/aerate" into a single sided header further improving its packing density another 10%, making the new system potentially 40% the size of the current Navy pretreatment system.

One technical hurdle is flow distribution of the various feed streams to maximize the effectiveness of all the service and cleaning steps: feed/drain/vent/aeration. The flow path for the aeration and drain step in the conceptual design is across the 6 inch side of the module. Whereas the Memtek flow path is along the entire 80 inch length of the module. We believe this provides shorter flow paths and more accurate distribution of cleaning and feed flows at lower pressure drops. Our proposed solution takes advantage of our abilities in FEA, flow dynamics software, and mathematical distribution programs we have written in conjunction with 2D/3D modeling prior to prototype development and production. Our expertise in flow distribution and analysis is demonstrated by success of the CoMatrix® coalescing filter, the proprietary Sparkle® back-washable hollow fiber module and by our proven track record with Bechtel, SNC Lavalin, CH2MHill and other major engineering firms where we have engineered products from concept to full-scale production.

The overall design allows the Navy to meet its militarized requirements, reduce space significantly, sample individual modules, replace a module with all the other modules in service and use any type of commercially available hollow fiber currently or in future.

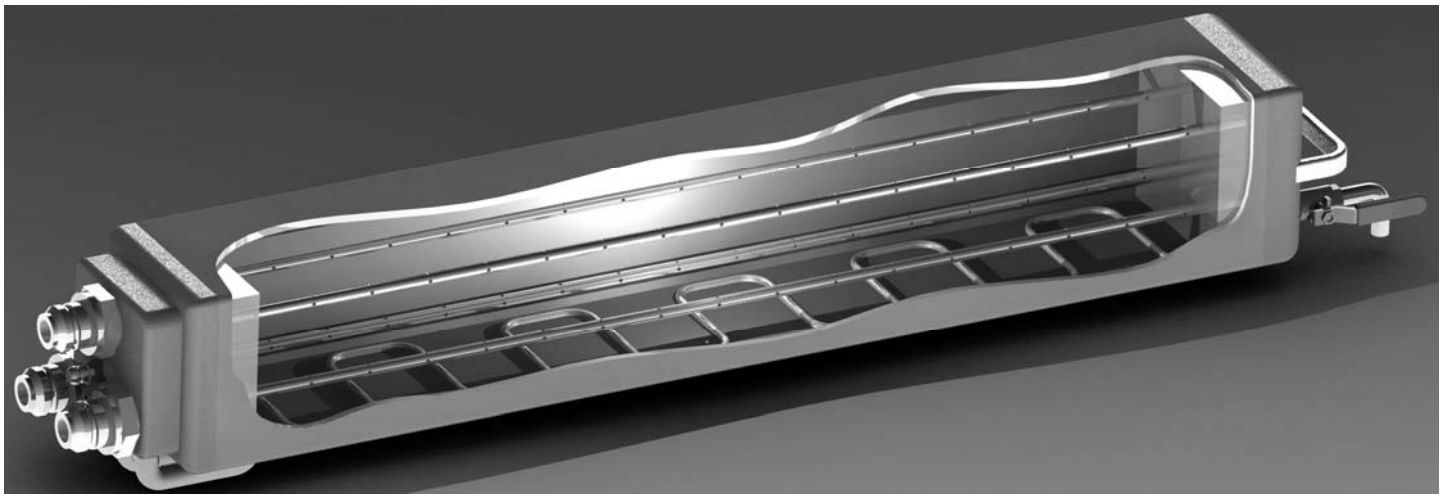
No exotic or hazardous materials requiring special storage are used and anticipated power requirements are 460V, 3 phase, 20 amps. Compressed air requirements are 40 psig with a ¼" hose. Effluent discharges to the ocean can be equal to the feed stream if the filtrate and cleaning streams are combined prior to discharge. There is no change in fluid temperature; no residual oxidants or heavy metals generated and we will not vary the pH of the seawater. All electrical ratings will be Nema 4X and no high- risk areas are associated with this project.

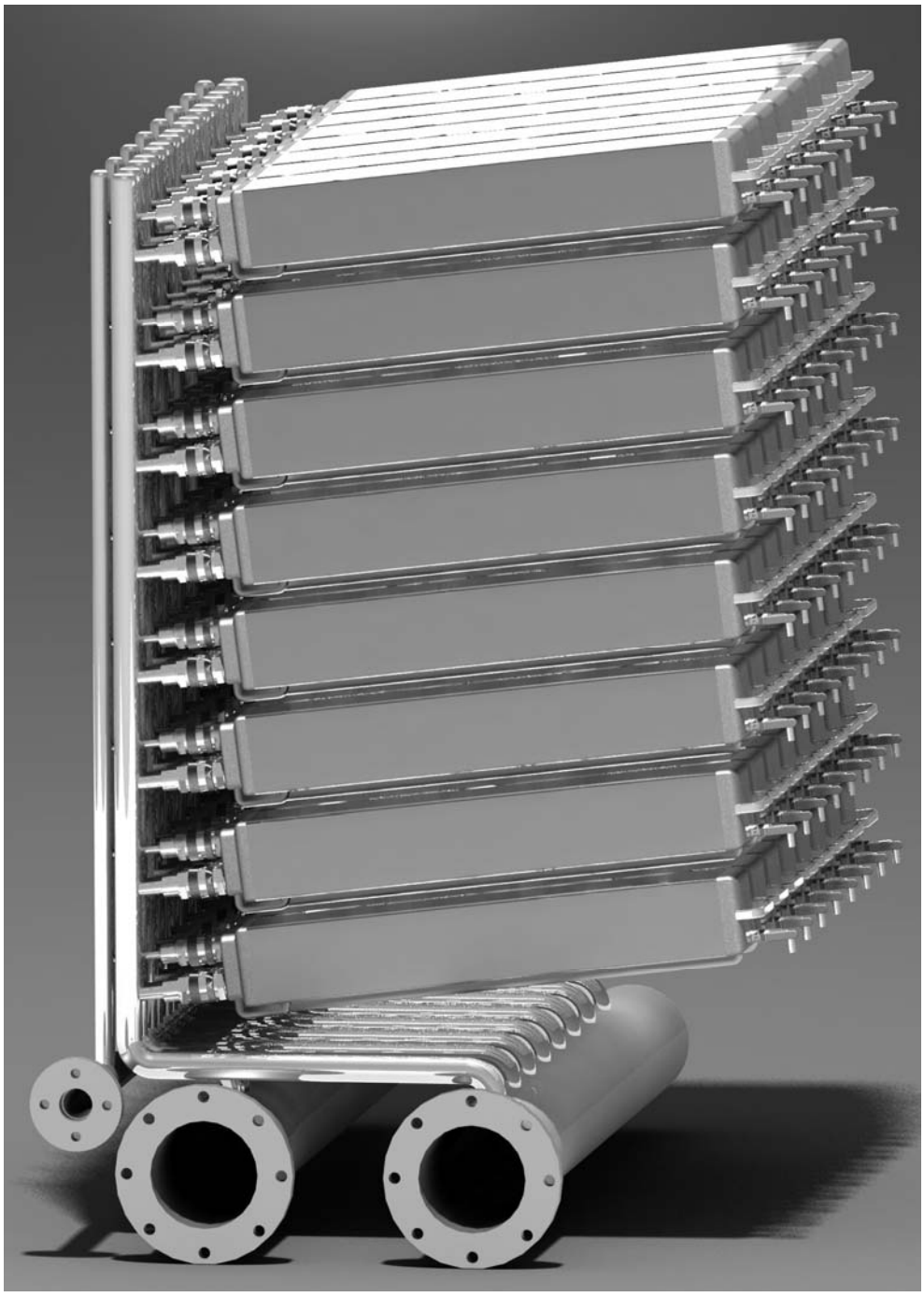
The government will be allowed to modify the test equipment and we will support the evaluation of the device at government facilities. We will replace damaged or defective components at cost and provide recommended spare parts and consumable items. We will not rely on government computers or equipment and an operational and maintenance manual will be provided.

Note in the below renditions the vent line is not shown. This line can come from the top of the module and still exit through a header with disconnects and the handle design.

The module design is flexible and is to take advantage of the operational and cleaning procedures of the Navy work. This means the module design could be vertical or horizontal and have whatever connections needed for service and cleaning. These basic design decisions would be made in concert with Naval personnel.

The drawing showing the 64 modules show this as a single bank for clarity. These of course could be changed to several banks of 8 modules or any desired configuration.





DELIVERABLES:

1. A detailed design of the “compact module” including material costs and bill of materials.
2. Prototype modules for bench scale testing
3. A design either incorporating or showing a clear path to the below listed requirements:
    a. Handle shock requirements of the Navy
    b. Handles vibration requirements of the Navy
    c. Handles motion and/or Unbalanced rotating components requirements of the Navy
    d. Meets or exceeds ship noise level requirements
    e. Will not create toxic fumes in a fire
    f. A system that is Electromagnetically compatible with ship board operations
    g. Meets corrosion in a sea water environment requirements
    h. Meets Navy Hazardous material policies
4. The design/construction of a “compact module” system with the following key features:
    a. A working system consisting of the key features of compactness, operational to the current backflushing/cleaning scheme of the Navy, and module removal without leakage.
    b. Packing density greater then 50% of the current Memtek (sixty-four) module system at Port Hueneme with better serviceability.
    c. Demonstrated scaleability to the 12,000 gpd RO pretreatment system
    d. Delivery to the Navy a complete operational and skid mounted system for field trials.
    e. A controller to automatically operate the delivered system
    f. Spare modules equal to those delivered as part of the main system.

Note: the system can be designed as either a vertical or horizontal module system. We believe the horizontal system can operate to the same cleaning scheme as the Memtech 80” module or, if desired, can be built in a vertical configuration much shorter with higher packing density.

PROGRAMMATIC SECTION:

MILESTONES AND TIME TABLE

PRELIMINARY DESIGN-consists of line drawings and technical write up to be reviewed by the Navy to ensure the design meets the flow path and flow requirements of the desired cleaning processes.

DETAIL DESIGN-Comments incorporated from the Navy into a detailed design suitable for construction of the system

COMPONENT PROTOTYPING-Individual module components are fabricated and testd for proper strength and flow characteristics.

DESIGN CHANGES-These are the design changes made based upon results of the previous task.

FABRICATION OF MODULES-Modules are manufactured and tested on a bench test rig to demonstrate flow paths and sizes are suitable for the modules water production and cleaning scheme.

SYSTEM FABRICATION-A system is fabricated to design specifications and loaded with a full set of modules.

COLD COMMISSIONING-The system is operated on filtered tap water to confirm functionality and control sequencing.

HOT COMMISSIONING-The system is operated on a sea water recipe at 42,000 mg/l and at a temperature of 105F.

DELIVERY TO NAVY-The system is crated for shipment with all pertinent documents including a detailed operational and maintenance manual.

TASK DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PRELIMINARY DESIGN	XX	XX	XX															
DETAIL DESIGN			XX	XX	XX													
COMPONENT PROTOTYPING					XX	XX												
DESIGN REVISION						XX												
FABRICATION OF MODULES						XX	XX	XX	XX	XX								
SYSTEM FABRICATION										XX	XX	XX	XX					
COLD COMMISSIONING														XX	XX			
HOT COMMISSIONING																XX	XX	
DELIVERY TO NAVY																		XX

Months for Task Duration

		Spintek Filtration, Inc									
		10863 Portal Drive									
		Los Alamitos, CA 90720 USA									
		Taxpayer ID Number		**42-1611251**							
Hours	**Total Hours**	PRELIM DESIGN	DETAIL DESIGN	PROTOTYPING	DESIGN CHG	FAB MODULES	SYSTEM FAB	COLD COMM	HOT COMM	DELIVERY	
Project Mgr	410	50	50	50	50	50	50	50	50	10	
Engineering	730	200	100	40	40	150	150	25	25	0	
Design	930	250	500	40	140	0	0	0	0	0	
Manufacturing	2835	0	0	250	0	1200	800	250	300	35	
Administrative	180	20	20	20	20	20	20	20	20	20	
Contracts Mgr	135	15	15	15	15	15	15	15	15	15	
Total Hrs/Task		535	685	415	265	1435	1035	360	410	80	
Salaries	**Hourly Rate**	PRELIM DESIGN	DETAIL DESIGN	PROTOTYPING	DESIGN CHG	FAB MODULES	SYSTEM FAB	COLD COMM	HOT COMM	DELIVERY	
Project Mgr	74.50	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 3,725.00	$ 745.00	
Engineering	45.00	$ 9,000.00	$ 4,500.00	$ 1,800.00	$ 1,800.00	$ 6,750.00	$ 6,750.00	$ 1,125.00	$ 1,125.00	$ -	
Design	30.00	$ 7,500.00	$ 15,000.00	$ 1,200.00	$ 4,200.00	$ -	$ -	$ -	$ -	$ -	
Manufacturing	28.00	$ -	$ -	$ 7,000.00	$ -	$ 33,600.00	$ 22,400.00	$ 7,000.00	$ 8,400.00	$ 980.00	
Administrative	26.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	$ 520.00	
Contracts Mgr	50.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	$ 757.50	
Subtotal Salaries		$ 21,502.50	$ 24,502.50	$ 15,002.50	$ 11,002.50	$ 45,352.50	$ 34,152.50	$ 13,127.50	$ 14,527.50	$ 3,002.50	
OH	49.63%	$ 10,671.69	$ 12,160.59	$ 7,445.74	$ 5,460.54	$ 22,508.45	$ 16,949.89	$ 6,515.18	$ 7,210.00	$ 1,490.14	
G&A	168.01%	$ 36,126.35	$ 41,166.65	$ 25,205.70	$ 18,485.30	$ 76,196.74	$ 57,379.62	$ 22,055.51	$ 24,407.65	$ 5,044.50	
Subtotal Salaries/OH/G&A		$ 46,798.04	$ 53,327.24	$ 32,651.44	$ 23,945.84	$ 98,705.18	$ 74,329.50	$ 28,570.69	$ 31,617.65	$ 6,534.64	$ 396,480
Services		$ -	$ 10,000.00	$ -	$ -	$ -	$ -	$ 15,000.00	$ 15,000.00	$ -	
Materials		$ -	$ -	$ 15,000.00	$ -	$ 42,000.00	$ 30,000.00	$ -	$ -	$ -	
Services/Materials Total		$ -	$ 10,000.00	$ 15,000.00	$ -	$ 42,000.00	$ 30,000.00	$ 15,000.00	$ 15,000.00	$ -	
HANDLING	20%	$ -	$ 2,000.00	$ 3,000.00	$ -	$ 8,400.00	$ 6,000.00	$ 3,000.00	$ 3,000.00	$ -	
TOTAL S&M		$ -	$ 12,000.00	$ 18,000.00	$ -	$ 50,400.00	$ 36,000.00	$ 18,000.00	$ 18,000.00	$ -	$ 152,400
TOTAL PROJECT EXPENSE											**$ 548,880**

RESUMES:

Primary Investigator:

Mr. William A. Greene is the principal investigator for this project. With over 20 years of experience in managing a successful membrane manufacturing company, this profitable small business also manufactures solvent extraction and coalescing products on a world wide basis. Mr. Greene has authored or co-authored six (6) United States patents ranging from advanced coalescing systems to rotating stainless steel membrane microfilters that have met with commercial success, especially at Department of Energy sites, where they are used for high level radioactive waste treatment.

Mr. Greene was the primary investigator and manager for a $1.1M Department of Energy grant under the Environmental Management (EM) program entitled "Centrifugal Membrane Filtration". He project managed two (2) high shear rotating microfilters for US DOE (Savannah River Project) that have successfully passed or exceeded all deliverables and a pilot project for DOE (Hanford) and CH2MHill which successfully passed the 500 hour "hot" testing phase to proceed to the next 1,000 hour testing phase for radioactive waste water cleanup.

Mr. Greene's "for profit" company has an emphasis on delivering quality filtration products worldwide *cost effectively*. He has installed hundreds of large-scale filter construction projects worldwide in the $2.2M to $3M range and several hundred full-scale "hydro-met" filtration filters with an average cost of $200K for each filter. He developed the 1" diameter tubular membrane; is now designing smaller diameter tubular products; and is the inventor of the basic concept of the proposed "square" hollow fiber module for the Navy.

Key Personnel:

Mr. Jason Gilmour is the primary technical contact for this project. Mr. Gilmour designed the rugged Sparkle® hollow fiber drinking water system (patent pending) producing a higher backpressure than feed to flush membranes with no external pumps; can be operated with no external power source; and can be used in developing countries or disaster areas.

He was the managing project engineer for two (2) advanced high shear rotating microfilters delivered to the US DOE (Savannah River Project) that successfully passed or exceeded all DOE deliverables. He engineered the pilot scale high shear rotating filter for DOE (Hanford) and CH2MHill for high level radioactive waste treatment. This small unit passed a 500 hour nuclear test and now is scheduled for a rigorous 1,000 hour test on radioactive waste water.

Mr. Gilmour supervises production and quality control of the 1" tubular membrane product. His responsibilities include installation of a full scale production facility for hollow fiber membranes scheduled for third quarter 2009. This includes scientific calculations; polymeric formulations; leaching and extrusion equipment; labor and potting 4" hollow fiber modules.

In addition to managing the engineering and commissioning of SpinTek's "hydro-met" filters he was the primary inventor of a new 9,200 gpm hydrometallurgical coalescer for separation of "small droplet" size organic from aqueous solutions. Mr. Gilmour is the primary inventor of the various practical ideas and design of the module shown in this proposal.